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Joseph C. Redmond, Jr.
43464 Foxgrove Court
Ashburn, VA 20147

EXAMINER	
RUTZ, JARED IAN	

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/716,136
Filing Date: November 18, 2003
Appellant(s): MENON ET AL.

Joseph P. Curtin
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 2/6/2009 appealing from the Office action mailed 9/3/2008.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

2004/0107400	Servi et al.	6-2004
2005/0015700	Hetzler et al.	2-2005

5,958,067 Kaneda et al. 9-1999

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Servi et al. (US Patent Application 2004/0107400 A1), hereinafter simply Servi.

Regarding claim 1, Servi teaches a method for protecting data stored in a RAID-configured storage system from uncorrectable media errors, the RAID-configured storage system having a plurality of storage units, the method comprising:

associating n data information sectors (Fig. 1, D 1-10; paragraph 44) with c redundancy information sectors (Fig. 1, P 1-6; paragraphs 45, 46), the c redundancy information sectors being based on the n data information sectors, and n and c being integer value numbers greater than zero; and

writing the n data information sectors with c redundancy information sectors on the same storage unit (paragraph 52, Servi discloses that data and parity set may be stored in different locations on the same storage medium).

Servi did not explicitly mention that the sectors should be "disk sectors" (e.g., RAID parity sectors), it would have been obvious to one having ordinary skill in the art at the time the invention was made to keep the parity data or Servi in dedicated disk sectors (as opposed to “tracks” or “clusters” or “blocks”) since (1) sectors were a well known disk partition size at the time of the invention (sectors are basically small sections of tracks) and (2) the Servi system utilized disks.

Claims 3, 8-9 and13-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Servi et al. (US Patent Application 2004/0107400 A1), hereinafter simply Servi, in view of Kaneda et al. (US Patent 5,958,067), hereinafter simply Kaneda.

Regarding claim 3, Servi teaches a method for protecting data stored in a RAID-configured storage system from uncorrectable media errors, the RAID-configured storage system having a plurality of storage units, the method comprising:

associating n data information sectors (Fig. 1, D 1-10; paragraph 44) with c redundancy information sectors (Fig. 1, P 1-6; paragraphs 45, 46), the c redundancy information sectors being based on the n data information sectors, and n and c being integer value numbers; and

writing the n data information sectors with c redundancy information sectors on the same storage unit (paragraph 52, Servi discloses that data and parity set may be stored in different locations on the same storage medium).

Servi fails to teach the RAID-configured storage system is configured as a RAID 5 storage system. Kaneda teaches a method, wherein the RAID-configured storage system is configured as a RAID 5 storage system (column 1, lines 34-62). At the time of invention it would have been obvious to a person of ordinary skill in the art to combine the Servi with Kaneda. The motivation for doing so would have been an improved response performance and throughput (column 3, lines 51-56).

Regarding claim 8, Kaneda teaches a method, wherein the redundancy information is an XOR-based code (column 11, lines 6-23).

Regarding claim 9, Kaneda teaches a method, wherein the redundancy information is a one-dimensional parity (column 9, lines 24-33).

Regarding claim 13, Kaneda teaches a method, wherein the n data information sectors and the c redundancy information sectors are written consecutively (Fig. 1, Disk 301, Kaneda shows the Data Area 391 and Parity Area 392 are written consecutively).

Regarding claim 14, Kaneda teaches a method, wherein the n data information sectors and the c redundancy information sectors are intermingled when written (Fig. 5, Disk 301, Kaneda shows the Data Area 391 and Parity Area 392 are intermingled when written).

Claims 2, 4-7 and 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Servi et al. (US Patent Application 2004/0107400 A1), hereinafter simply Servi, in view of Hetzler et al. (US Patent Application 2005/0015700), hereinafter simply Hetzler.

Regarding claim 2, Servi teaches a method for protecting data stored in a RAID-configured storage system from uncorrectable media errors, the RAID-configured storage system having a plurality of storage units, the method comprising:

associating n data information sectors (Fig. 1, D 1-10; paragraph 44) with c redundancy information sectors (Fig. 1, P 1-6; paragraphs 45, 46), the c redundancy information sectors being based on the n data information sectors, and n and c being integer value numbers; and

writing the n data information sectors with c redundancy information sectors on the same storage unit (paragraph 52, Servi discloses that data and parity set may be stored in different locations on the same storage medium).

Servi fails to teach the RAID-configured storage system is configured as a RAID 6 storage system. Hetzler teaches a method, wherein the RAID-configured storage system is configured as a RAID 6 storage system (Paragraph 34). At the time of invention it would have been obvious to a person of ordinary skill in the art to combine the Servi with Hetzler. The motivation for doing so would have been an improved performance, protection and efficiency (See Hetzler, paragraph 20).

Regarding claim 4, Hetzler et al. teach a method, wherein the RAID-configured storage system is configured as a RAID 51 storage system (paragraph 35).

Regarding claim 5, Hetzler et al. teach a method, wherein the RAID-configured storage system is configured as a RAID 3+3 storage system (paragraphs 27 and 30).

Regarding claim 6, Hetzler et al. teach a method, wherein the RAID-configured storage system is configured as a RAID N+3 storage system (paragraph 34).

Regarding claim 7, Hetzler et al. teach a method, wherein the redundancy information is based on a Reed-Solomon code (paragraph 21 and 31).

Regarding claims10, Hetzler et al. teach a method, wherein the storage unit is a hard disk drive (paragraph 27).

Regarding claim 11, Hetzler et al. teach a method, wherein the storage unit is an optical drive (paragraph 27).

Regarding claim 12, Hetzler et al. teach a method, wherein the storage unit is a random access memory (paragraph 27).

(10) Response to Argument

Response to Applicant's argument I, beginning on page 3 and continuing through page 13.

With respect to Applicant's arguments in paragraphs A1-A2, the Examiner respectfully notes that the example given in figure 1 shows 10 data symbols and 6 redundancy information symbols. 10 and 6 are each integer value numbers greater than zero. Paragraph 0044 explicitly teaches that any suitable data symbol size may be used, and notes that a larger data symbol size simplifies the formation of the graph by

reducing the number of points to be created. Paragraph 0045 shows that the parity symbol size may correspond to the data symbol size. Paragraph 0052 shows that the data set and the parity set may be stored on the same storage medium.

In paragraph A4, with respect to the teaching of Servi, Applicant argues:

> *"Servi discloses one embodiment that "enables a user to specify the number of bits in the data set, as well as the maximum number of parity bits that the user is willing to support." (See Servi, paragraph [0073], underlining added.) In particular, Servi discloses that Tables 5-8 may be used as a guide for selecting appropriate values. (See Servi, paragraph [0077].) Tables 5-8 of Servi show that to achieve a relatively small expected percentage loss of data bits, parity points having a relatively high degree should be used. For example, in Table 5, for a 1% expected loss for a data set of 5040 bits, the parity degree of the parity bits should range from 160 to 200. According to Servi, the number of parity bits for a 1% expected loss in data is 130 bits. For an expected 10 % loss of 5040 data bits, the parity degree of the parity bits should be range from 18 to 25 bits. The number of parity bits for an expected 10 % lost of data bits is 860. Tables 6-8 show similar information."*

The Examiner respectfully notes that the claims do not prohibit a user from specifying the number of bits in the data set or the maximum number of parity bits. Additionally, the claims of the instant application do not require that the number of redundancy information sectors are selected so as to provide a specific level of protection against data loss. Further, the Examiner respectfully notes that the embodiment referred to in paragraph 0073 was not relied upon by the Examiner to teach claim 1. The examples given in table 5 provide a particular target reliability against a specific percentage of data loss for a specific number of data bits, and those specific levels are not required by the claims.

In paragraph A5, with respect to the teaching of Servi, Applicant argues:

> "*Applicants respectfully submit that to consider the relevance of the Servi technique to the claimed subject matter, imagine ten (10) data information disk sectors in which each data information disk sector size is 512 bits for a total of 5120 bits. Note that the number of total bits - 5120 - is an integer. If, by way of example, the Servi exemplary case in Table 5 of 5040 bits is scaled to correspond to the ten data information disk sectors of 5120 bits (i.e., using a scale factor of approximately 1.01590), none of the number of Servi parity bits for the exemplary percentage loses (i.e., 1%, 10 %, 20 %, 50%, and 75 % loses) scale to be an integer value.*"

The Examiner respectfully disagrees with Applicant's analysis of Servi, and respectfully submits that Applicant has not considered the teachings of Servi in considering how to calculate the required number of parity symbols, and respectfully submits that Servi does not teach using a scale factor to determine the value of N. Servi, at paragraph 0081, teaches that interpolation may be used to estimate values for n.

Additionally, the Examiner notes that using Applicant's scale factor does not give results which are accurate between data symbol sizes for the explicit examples given in tables 5 and 7. Using Applicant's technique to convert between 5040 data bits and 2520 data bits gives a scale factor of 2520/5040, or 0.5. Applying this scale factor to the number of parity bits needed to tolerate a 1% loss in table 5 suggests that 65 parity bits would be necessary for 1% loss in table 7. However, table 7 shows that 80 parity bits are necessary.

Table 2, in paragraph 0058 of Servi, teaches that the total number of parity points in the graph, z, is the sum of all values of N_j from j=1 to imax, which is the maximum value of j. Paragraphs 0059-0060 show that it is desirable to have an integral number

of parity points. Table 3 shows an illustrative implementation for rounding the values of N_j to an integer. The Examiner notes that this formula shows that sum of all values of N_j from j=1 to imax (which is equal to z, or the total number of parity points, as shown in table 2) uses the Int operator, which is explained in paragraph 0060 as producing an integer number. Accordingly, following the teachings of Servi will always result in an integer number of parity points.

Additionally, as taught by Servi at paragraphs 0044 and 0045, a parity point is not limited to a single bit.

In paragraph A6, with respect to the teaching of Servi, Applicant argues:

> *"Plainly, Servi is not relevant to the subject matter of claim 1, and the Examiner's assertion is without merit that the Servi data points D correspond to the claimed data information disk sectors and that the Servi parity points P correspond to the claimed redundancy information disk sectors. That is, a Servi data point D does not correspond to a claimed data information disk sector, and a Servi parity point P does not correspond to a claimed redundancy information disk sector."*

The Examiner respectfully notes that paragraphs 0059 and 0060 show that the formula given in table 3 may be used to calculate the number of parity points for a given number of data points, the number of data points being represented by k. Paragraph 0045 shows that a parity point represents a parity symbol that includes one or more bits of the parity set, and is not limited to a single bit. As noted in paragraph 0044, a larger symbol size is desirable. The Examiner acknowledges that Servi does not expressly teach that a data or parity symbol is a disk sector; the obviousness of applying the teachings to data and parity symbols corresponding to disk sectors is the Examiner's

conclusion after determining the scope and content of the prior art, ascertaining the differences between the claimed invention and the prior art, and resolving the level of ordinary skill in the art. The Examiner respectfully notes that the determination of obviousness is addressed in more detail infra.

In paragraph A7, with respect to the teaching of Servi, Applicant argues:

> "*Moreover, it is respectfully noted that in the stated rejection the Examiner has not taken the initiative to use any of the disclosed Servi techniques (i.e., Tables 1 and/or 4 and Tables 5-8) for generating parity bits based on a specified number of data bits such that c redundancy information disk sectors are generated based on n data information disk sectors, and such that n and c are integer value numbers greater than zero.*"

The Examiner respectfully submits that, as discussed supra with respect to Applicant's argument in paragraph A5, Servi teaches that the number of parity symbols for a given number of data symbols will always result in an integer number when calculated as taught by Servi in paragraphs 0059 and 0060.

In paragraph A8, with respect to the teaching of Servi, Applicant argues:

> "*It should be noted that Applicants have respectfully invited the Examiner (and the Examiner is still invited) to prove how any of the techniques disclosed by Servi can be used to generate parity bits for a selected number of data bits that yields c redundancy information disk sectors that are based on n data information disk sectors such that n and c are integer value numbers greater than zero. Even though Servi discloses one embodiment that "enables a user to specify the number of bits in the data set, as well as the maximum number of parity bits that the user is willing to support" (see Servi, paragraph [0073], underlining added), the Examiner has not responded to Applicants' invitation. Consequently, Applicants consider the Examiner's lack of response to be a tacit admission by the Examiner that the Examiner cannot prove that any of the techniques disclosed by Servi to generate parity bits for a selected number of data bits that*

yields c redundancy information disk sectors that are based on n data information disk sectors such that n and c are integer value numbers greater than zero."

The Examiner respectfully notes that claim 1 does not recite generating parity bits, but rather associating n data information sectors with c redundancy information sectors. Additionally, the Examiner respectfully notes that tables 5, 6, and 7 of Servi each show a plurality of examples where an integer number of parity symbols have been calculated for an integer number of data symbols. In these examples, the symbol size is 1 bit, however Servi teaches that the symbol may be any size at paragraphs 0044-0055. In table 5, the example cited by applicant, for 5040 data symbols and targeting 10^{-6} reliability, for a 1 percent expected loss rate 130 parity symbols are required. 5040 and 130 are both integer value numbers greater than zero. Additionally, the Examiner respectfully notes that in the example shown in figure 1, for 10 data symbols there are 6 associated parity symbols. Again, for the reasons presented with respect to Applicant's argument in paragraph A5, following the teachings of Servi will always result in an integer number of parity symbols for an integer number of data symbols.

With respect to applicant's argument in paragraph A9, the Examiner respectfully notes that paragraph 0052 was not cited to teach the n data information sectors or the c redundancy information sectors. Paragraph 0052 was cited to teach that the parity symbols and data symbols may be stored on the same storage medium, and that that storage medium may be a disk drive. Paragraphs 0044-0046 and figure 1 were cited to teach the n data information sectors and the c redundancy information sectors.

In paragraphs B2-B4, with respect to the Examiner's reasoning for modifying Servi, Applicant argues:

> "*Regarding this conclusion, Applicants respectfully submit that: "To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or the examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references." Ex parte Clapp, 227 USPQ 972, 973 (Bd. Pat. App. & Inter. 1985). (See, also, MPEP §§ 706.02(j) and 2144.)*
>
> *In the present instance, the Examiner has not stated that Servi expressly or impliedly suggests the claimed subject matter.*
>
> *Consequently, in order to support the present rejection, the Examiner's line of reasoning must be convincing as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.*"

The Examiner notes that paragraph 0044 of Servi states "*It should be appreciated that any suitable data symbol size may be used, as the invention is not limited in this respect.*" and "*A larger data symbol size may be used, which simplifies the formation of the graph by reducing the number of points to be created.*" Accordingly, the Examiner respectfully submits that Servi suggests using a symbol size larger than a single bit, but the exact size of the symbol size is not considered vital to the correctness of the technique of Servi. Servi also teaches that the data and parity symbols may be stored on the same disk at paragraph 0052.

As noted by the Examiner in the rejection of claim 1 under 35 USC 103(a) as being unpatentable over Servi, disk sectors are a well known unit for disk partitioning, as they are the smallest physical unit accessed. The Examiner notes that Applicant does not dispute that sectors are a well known unit of storage in disk drives.

Accordingly, As Servi teaches that the size of the data symbol is not critical, and that larger symbol sizes simplify the formation of the graph (paragraph 0044), and as it is well known in the art that sectors are the smallest physical unit on a disk drive, the Examiner maintains that the selection of a sector as a symbol size would have obvious to one of ordinary skill in the art.

With respect to Applicant's arguments in paragraphs C1-C16, in regard to what Applicant alleges is the Examiner's reasoning for modifying Servi, the Examiner respectfully disagrees with Applicant's characterization of the quoted section. The statements to which Applicant refers were not based on Servi. The issue was first raised at page 8 of the final rejection mailed 1/5/2007 as a comment by the Examiner as a comment on the apparent breadth of the claims. As these comments were not a rejection made against the claims, the Examiner respectfully submits that they are not appealable, and at the very least, are not germane to the rejection of claim 1 under 35 USC 103(a) as being unpatentable over Servi.

With respect to Applicant's arguments in paragraphs D1-D7, the Examiner respectfully submits that the points raised by Applicant have been addressed supra.

In paragraph E3, with respect to the teaching of Servi, Applicant argues:

> *"Additionally, Applicants respectfully submit that a person of ordinary skill in the art would simply not use or modify the Servi technique to obtain the subject matter of claim 1 because in order to use or modify Servi to become the subject matter of claim 1, common sense dictates that the high expected percentage loss*

of data bits provided by Servi would be plainly unacceptable to one of ordinary skill in the art, particularly in view of the environment of claim 1. (Note the high-percentage losses of 1%, 10%, 20%, 50% and 75% disclosed by Servi in Tables 5-8.)"

The Examiner respectfully notes that the disclosure of Servi is directed to preventing data loss in the event of loss of data symbols, see paragraph 0042. Accordingly, one of ordinary skill in the art would recognize that Servi is not encouraging people to lose between 1% and 75% of their data, but rather is teaching how to prevent the loss of the information stored in the event of the corruption or loss of that percentage of data symbols.

In paragraph E4, with respect to the teaching of Servi, Applicant argues:

"*Further still, Applicants respectfully submit that if it really was so obvious to modify Servi as proffered by the Examiner, then why cannot Applicants and the Examiner modify Servi to form the subject matter of claim 1?*"

The Examiner respectfully notes that, while unable to speak to Applicant's inability to modify Servi to form the subject matter of claim 1, the only modification to Servi to meet claim 1 is to make the size of the data symbols the size of a disk sector, and the reasoning for doing so is discussed supra.

With respect to Applicant's arguments in paragraphs E5-E9, the Examiner respectfully submits that the rationale for modifying Servi is addressed supra.

Response to Applicant's argument II, beginning on page 13 and continuing through page 14.

With respect to Applicant's arguments with respect to the rejection of claims 3, 8, 9, 13, and 14 under 35 USC 103(a) as being unpatentable over Servi in view of Kaneda and with respect to the rejection of claims 2, 4-7, and 10-12 under 35 USC 103(a) as being unpatentable over Servi in view of Hetzler, the Examiner respectfully disagrees for the reasons presented supra.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Jared Rutz

/Jared Rutz/

Conferees:

/Kevin L Ellis/
Acting SPE of Art Unit 2187

/Reginald G. Bragdon/
Supervisory Patent Examiner, Art Unit 2189